AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions and listings of claims in the application.

Listing of Claims

1. (Currently Amended) A phase modulator, comprising:

a phase-locked loop having a phase frequency detector, a low-pass modulation input coupled to the phase frequency detector, a voltage controlled oscillator, and a high-pass modulation input coupled to the voltage controlled oscillator; and

a trimming circuit connected between the phase frequency detector and the voltage controlled oscillator, the trimming circuit configured to receive an error signal ~~from~~ generated by the phase frequency detector and to control a gain of the high-pass modulation input such that the high-pass modulation input and the low-pass modulation input together form an all-pass modulation input to the voltage controlled oscillator;

wherein the trimming circuit forms a feedback control loop together with the phase-locked loop to automatically calibrate gain estimation and variation of the voltage controlled oscillator.

2. (Original) The phase modulator of claim 1, wherein the trimming circuit is configured to apply an estimate of the gain of the voltage controlled oscillator to the voltage controlled oscillator.

3. (Withdrawn) The phase modulator of claim 1, wherein the phase frequency detector comprises a first charge pump and a second charge pump, and the error signal comprises a feedback component from the first charge pump and a gain control component from the second charge pump.

4. (Currently Amended) A phase modulator, comprising:

a phase-locked loop having a phase frequency detector, a low-pass modulation input coupled to the phase frequency detector, a loop filter, a voltage controlled

oscillator, and a high-pass modulation input coupled to the voltage controlled oscillator; and

a trimming circuit connected between the phase frequency detector and the voltage controlled oscillator, the trimming circuit including a ~~loop~~ filter configured to control a dynamic behavior of the trimming circuit, wherein the trimming circuit is configured to receive an error signal ~~from~~ generated by the phase frequency detector and to control a gain of the high-pass modulation input such that the high-pass modulation input and the low-pass modulation input together form an all-pass modulation input to the voltage controlled oscillator.

5. (Currently Amended) The phase modulator of claim 4, wherein the ~~compensation circuit is located in parallel with~~ input of the trimming circuit is connected to the input of the loop filter.

6. (Currently Amended) The phase modulator of claim 4, wherein the input of the trimming circuit is ~~located after~~ connected to the output of the loop filter.

7. (Previously Presented) A phase modulator, comprising:

a phase-locked loop having a phase frequency detector, a low-pass modulation input coupled to the phase frequency detector, a voltage controlled oscillator, a high-pass modulation input coupled to the voltage controlled oscillator, and a variable amplifier coupled to the voltage controlled oscillator for introducing an estimation of the gain of the voltage controlled oscillator to the voltage controlled oscillator based upon a center frequency of a desired output signal of the voltage controlled oscillator; and

a trimming circuit connected between the phase frequency detector and the voltage controlled oscillator, the trimming circuit configured to receive an error signal from the phase frequency detector and to control a gain of the high-pass modulation input such that the high-pass modulation input and the low-pass modulation input together form an all-pass modulation input to the voltage controlled oscillator.

8. (Withdrawn) The phase modulator of claim 7, wherein the voltage controlled oscillator has a separate modulation input for receiving an output of the variable amplifier.

9. (Canceled)

10. (Previously Presented) A phase modulator, comprising:

a phase-locked loop having a phase frequency detector, a low-pass modulation input coupled to the phase frequency detector, a voltage controlled oscillator, and a high-pass modulation input coupled to the voltage controlled oscillator; and

a trimming circuit connected between the phase frequency detector and the voltage controlled oscillator, the trimming circuit configured to receive an error signal from the phase frequency detector and to control a gain of the high-pass modulation input such that the high-pass modulation input and the low-pass modulation input together form an all-pass modulation input to the voltage controlled oscillator, wherein the trimming circuit comprises:

a loop voltage amplifier configured to amplify the error signal upon receipt of a start signal;

a delay and limit section configured to delay and limit a modulation signal provided to the high-pass modulation input;

a mixer configured to mix the amplified error signal with the delayed and limited modulation signal; and

an integrator configured to integrate the mixed signal, wherein the integrated mixed signal is used to control a gain of the modulation signal provided to the high-pass modulation input.

11. (Original) The phase modulator of claim 10, wherein loop voltage amplifier includes a low-pass filter configured to filter the error signal and a differential amplifier configured to amplify the filtered error signal.

12. (Original) The phase modulator of claim 11, wherein the loop voltage amplifier further includes a transconductance cell in a feedback path of the differential amplifier, and wherein switching a transconductance of the transconductance cell between a high value and a low value transforms the differential amplifier into a bandpass amplifier.

13. (Original) The phase modulator of claim 1, wherein the phase modulator is configured to be used in an Enhanced Data GSM Environment communication system.

14. (Original) The phase modulator of claim 1, wherein the phase modulator is configured to be used in a Wideband Code Division Multiple Access communication system.

15. (Currently Amended) [[In]] A method of automatically calibrating gain estimation and variation of a voltage controlled oscillator in a phase modulator having a phase-locked loop that includes a phase frequency detector, a loop filter, a low-pass modulation input coupled to the phase frequency detector, a voltage controlled oscillator, a high-pass modulation input coupled to the voltage controlled oscillator, and a trimming circuit, ~~a method of controlling a gain of the voltage controlled oscillator~~ wherein the trimming circuit forms a feedback control loop together with the phase-locked loop, said method, comprising:

receiving an error signal ~~from~~ generated by the phase frequency detector in the trimming circuit; ~~and~~

filtering the received error signal to control a dynamic behavior of the trimming circuit; and

controlling a gain of the high-pass modulation input using the trimming circuit and the error signal such that the high-pass modulation input and the low-pass modulation input together form an all-pass modulation input to the voltage controlled oscillator.

16. (Currently Amended) The method of claim 15, further comprising applying an estimate of the gain of the voltage controlled oscillator to the voltage controlled oscillator via the trimming circuit.

17-18. (Canceled)

19. (Currently Amended) The method of ~~claim 18~~ claim 15, wherein the trimming circuit receives the error signal ~~is by the trimming circuit after it has been filtered~~ from the phase detector before the loop filter.

20. (Currently Amended) The method of ~~claim 18~~ claim 15, wherein the trimming circuit receives the error signal ~~is by the trimming circuit before it has been filtered~~ after the loop filter.

21. (Currently Amended) The method of claim 15, further comprising introducing an estimation of the gain of the voltage controlled oscillator to the voltage controlled oscillator based upon a center frequency of a desired output signal of the voltage controlled oscillator ~~using~~.

22. (Withdrawn) The method of claim 21, wherein the voltage controlled oscillator has a separate modulation input for receiving the estimation of the gain of the voltage controlled oscillator.

23. (Original) The method of claim 15, further comprising combining the low-pass modulation input and the high-pass modulation input.

24. (Original) The method of claim 15, wherein the step of controlling the gain of the high-pass modulation input comprises:

amplifying the error signal upon receipt of a start signal;

delaying and limiting a modulation signal provided to the high-pass modulation input;

mixing the amplified error signal with the delayed and limited modulation signal; and

integrating the mixed signal, wherein the integrated mixed signal is used to control a gain of the modulation signal provided to the high-pass modulation input.

25. (Original) The method of claim 24, wherein the step of amplifying the error signal includes low-pass filtering the error signal and differentially amplifying the error signal.

26. (Original) The method of claim 25, the step of amplifying the error signal further includes transforming the error signal into a bandpass signal.

27. (Original) The method of claim 15, wherein the method is used in an Enhanced Data GSM Environment communication system.

28. (Original) The method of claim 15, wherein the method is used in a Wideband Code Division Multiple Access communication system.

29. (Canceled)